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ABSTRACT

This report focuses on and suggests ways of using instructional technology to provide better education/training delivery systems, especially the use of interactive videodiscs. The first chapter discusses the need for technology-based training; describes the computer interface components, functions, and characteristics of interactive videodisc systems; considers the theoretical principles involved in designing instruction to enhance learning; provides a historical perspective on the development of interactive videodiscs including the names of companies that were forerunners in the field; and lists current interactive videodisc manufacturers. Citing information from an extensive literature review of conceptual reports and experimental studies, the second chapter discusses future instructional uses of interactive videodiscs; the purchasing and integration of hardware components into workable systems; and the development and pilot testing of software programs. The chapter concludes with five general statements about interactive videodisc systems. The discussion of instructional design for adult learners in the third chapter includes information on the learning process and four phases of development peculiar to adults. The last chapter summarizes the potential uses of interactive instruction and notes factors that may inhibit its use in education. A list of the literature cited is provided. (DJR)

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EFFECTIVENESS OF INTERACTIVE VIDEODISC TRAINING: A COMPREHENSIVE REVIEW

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EFFECTIVENESS OF INTERACTIVE VIDEODISC TRAINING: A COMPREHENSIVE REVIEW

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CHAPTER ONE

INTERACTIVE VIDEODISC TO DATE

Competence, knowledge, skill, persistence, attitude, talent, timing, quickness, sensitivity; these are attributes everyone looks for in an employee. These are commodities which individuals trade for their salary, position and opportunity. As an aggregate, they represent the basic resource of a nation; but this is not a natural resource.

Capacity to learn may be passed on from parents to the off spring, however, knowledge and skill are not. Every generation is faced with the same problem of transferring an accumulated body of information—one that is growing and expanding at an unprecedented rate--to a new generation of workers who enter the workforce unprepared to assume the responsibilities awaiting them.

> While the information explosion has brought a vast and growing amount of knowledge to our doorstep, we are fast reaching the human limits of our ability to absorb and use it. Scholars note that while knowledge is expanding

> exponentially, our human rate of acquisition is significantly less and the proportion of knowable knowledge that we possess is growing smaller and smaller. In short, we are experiencing the start of what has been called a massive "ignorance explosion." (Molnar, 1979 , p.11).

This business of transferring information from one generation to another or from one group of individuals to another is the general topic of this report. It also addresses more specific questions: How can current approaches to training and education be improved? How can the costs of education be contained or reduced? How can emerging technology be captured to lead to better educational delivery systems at more reasonable costs?

Human-kind has passed through several historical stages to arrive at its present level of development: The development of high skill levels in hunting and gathering; Agricultural expertise in a manorial economy; industrialism; and ultimately considerable ability in providing information and services in a post industrial state. This progress, if indeed it is progress, was achieved through the successful transfer of information from one generation to its successor. At first only informal mechanisms were used--a mother instructing her children, a father demonstrating skills to his youngsters. Later, instructional roles specialized as shamans , master artisans and teachers assumed responsibility for transferring existing technology. Eventually, formal mechanisms were developed which included schools, teachers, educational policy boards and so on. Early commercial enterprises developed apprenticeship systems; craft guilds were formed to foster and regulate the transfer process. Certification followed with formal vocational training to support an increasing degree of job

specification.

Within our own memory span, this business of transferring knowledge, skills and attitudes has become big business. In this country and in others, public and private institutions were given the responsibility and necessary public monies to develop their human resources. Until recently that mandate was considered by many to be almost unconditional. Budgets for the public schools expanded year after year; fields of study proliferated; the teaching profession organized and established a methodological tradition. This complex establishment of public and private training institutions flourished throughout the first half of this century, particularly during the period following the second world war. In this quarter century, advances in knowledge have been the largest single source of long-term economic growth for the United States, accounting for more than one-third of our economic output (National Science Board, 1976). Recently, however, the unchecked growth of expenditures for education has been halted. State and federal subsidies to education have been sharply reduced and property-based taxing mechanisms overburdened. Public suport has diminished, with detractors claiming the educational institution has lost sight of the goal of developing basic skills. Educators and the public are demanding reform, insisting that social frills be excluded, more effective methods be adopted, and greater results be obtained for the dollars expended.

In some quarters, there is great pessimism that the educational

enterprise will not be able to respond to the challenge. The pessimistic observers claim procedures and methodologies have become so institutionalized--bound by tradition, labor contracts, professioal ethical and unrealistic expectations-- the system is incapable of changing itself. Other, less fatalistic observers predict that when educators are convienced the system has indeed reached the breaking point, they will begin to seek workable solutions. Educators will realize the unbridled growth pattern and timeworn procedures and methodologies cannot continue: they will find a means to carry out the task of transfering an ever increasing body of knowledge to new generations of learners. They will find ways to do so within diminishing budgets. Educators of this bent are turning to technology.

Hiscox (1981, p.3) believes the use of instructional technology will produce at least four benefits for educators and trainers:

a. Increased achievement by the earner;
b. More interesting instructional materials.
c. More efficient testing of what learners accomplish
d. Less clerical work for instructors and trainers.

Molnar argues along the same lines:

> Technological systems may be capable of organizing information into a form that can improve learning and extend long term memory well beyond the mnemonic devices used in memory training. (Molnar, 1979, p.12).

New hybrid computer/television technologies may be used to represent complex information or concepts and offer the learner powerful analytic

tools for solving problems. Comprehension may be increased by transforming abstract ideas from one form of representation to another or by presenting them in different forms and unique ways. New delivery vehicles may permit us to combine media and take advantage of different brain functions, facilitating and amplifying human reasoning. With an eye on the use of technology to achieve greater learning within a fixed cost structure, many educators and trainers have been paying special attention to a new medium: interactive videodisc technology.

> Interactive Instruction may be defined as: a form of instruction based upon random accessibility of a very large textual, visual and audio database. A population of predesigned instructional motion, and still images, audio and visual reinforcement and feedback segments are retrieved from this base in a pattern which is determined by each learner. Continued and frequent learner intervention, alters the course of instruction in a way which is relevent to each learner's needs. The instructional system responds instantly to learner input, offering a scope, rate, sequence, style, sophistication level, and medium which is, to a large degree determined by a dialog which is held between the learner and the system.

INTERACTIVITY

Of the three videodisc formats, the optical system offers an important option to the user in the form of an interactive computer interface. This interface is the key to genuine interactivity between the user and the vast amounts of information that can be stored on the videodisc. A complete interactive system must have five components: a videodisc player, a computer, a television monitor, an interface device and videodisc and computer software encoded on discs.

The function of the software is to store pre-planned instructional strategies, visual images (motion and still) audio signals, selection menus, quiz items, simulations, diagnostic routines, etc. The player functions to retrieve information from the disc as commanded by the computer program or as initiated by the user. The monitor serves as the display screen for both computer and videodisc images, although occasionally two screens, a CRT showing computer text, and a video monitor, showing images from the videodisc are used in tandem. The computer provides the system with its "intelligence"--the instructional programming and search algorithm created by the instructional design team. The interface allows the computer and videodisc player to "talk" to each other, with the computer sending search messages to the videodisc player, and the player responding with messages

relative to the status of the search.

A truly interactive videodisc system has the following characteristics:

1. Materials are encoded on the disc in a modular rather than a linear form. DeBloois (1982) describes this as a matrix design.

2. Users create unique lesson sequences based on their own interest and learning style by selecting from hundreds of pre-planned options.

3. As learners engage the system in an interactive dialog, the system responds with appropriate feedback, instructional sequences or additional options to provide the user with materials appropriate to their (a) interest, (b) ability, (c) learning style preference, (d) pace, (e) language.

The lesson is created as the result of a genuine interaction between the learner and a data base of visual, textual and audio cues recorded on optical and magnetic memory.

The substantial advantages claimed by proponents of interactive videodisc instruction are increasingly being supported by empirical research evidence (which will be reported later) and by learning theory research. The latter points to principles from the behavioral sciences which suggest that interactive videodisc systems create an environment that is likely to optimize learning. Computer-based instruction offers the learner an opportunity to respond to stimuli and to receive appropriate reinforcement, enhancement or remediation. According to Fleming and Levie (1978) this feature alone (interaction) is a sound principle of

instructional message design. Add to this feature the images and sound of the videodisc—providing learners high quality simulations of realistic objects, situations, or procedures--and you create an optimal condition for learning.

INSTRUCTIONAL MESSAGE DESIGN (Fleming and Levie, 1978) lists theoretical design principles which, when implemented, should improve learner performance.

> "In general, where the learner reacts to or interacts with the criterial stimulus, learning is facilitated, and that facilitation increases with the degree of learner activity or involvement." (p.138).

Fleming and Levie offer examples of interaction which should be designed into the lessons in order to implement the intent of this principle:

1. answering learners questions immediately after instruction;
2. timely correction of mistakes;
3. timely reinforcement of correct answers;
4. learner initiated repetition of material;
5. repetition of previously missed items;
6. learner control over lesson sequence.

Another principle of interaction listed by Fleming and Levie (1978, p.137) suggests that more learning will occur as the learner deepens his or her degree of involvement in the prepared materials: moving from simple (1) attending (reading, looking, listening), to (2) covert responding (repeating words subvocally), to (3) overt responding (responses taking the form of some observable action such as writing, typing, drawing, speaking,

choosing options, etc.).

A well designed, high quality interactive videodisc using audio and visual stimuli, computer text and graphics, designed to draw learners into more intense overt responding genuinely implements the intent of this principle. Other important message design principles are incorporated by the very nature of the medium. For example, Pictures of objects, being more concrete than the name of the object alone, promote better memory (or learning) than their written name. Concepts about concrete objects are more readily formed than concepts about abstract contracts. More learning takes place when information is presented concurrently in two modalities than when in just one. That is, when a learner can see pictures of a concept or object, hear an audio description and read in the abstract concerning its attributes, more learning will occur that through seeing, hearing or reading alone. Observing the action of another person (a model), the prior learning of words for objects and actions, and receiving appropriate instructions, all facilitate concept learning.

The interactive videodisc offers educators and trainers an opportunity to expand beyond the limitations that are present in almost all computer-aided instructional systems. Used as described above, the computer/videodisc system represents a truly individualized approach to training, incorporating the best of all other media. Approaches to instruction are being developed which were unheard of a few years ago: surrogate travel, interactive movies, electronic libraries,

action/consequence simulations and more.

There is good reason to be optimistic that we really stand on the edge of an exciting new era for trainers and educators. The juxtaposition of instructional designer, subject matter expert, computer and videodisc equipment, and learner, forms a new configuration allowing these resources to interact in completely new ways to improve the outcomes of training and instruction.

Industry, business, the military, government and education are exploring the potential of interactive videodisc. Current training applications include everything from low level knowledge transmission to skill development and high level simulations of complex problem solving. Archival applications are becoming more widely used by museums, libraries and collectors, and point-of-sale applications are widespread.

Schuyler (1983) discusses "market inter-dependence" and how growth in one market influences the growth of another in the videodisc industry. The interdependence of four markets-- consumer, industrial, educational and speciality, can be illustrated as a cycle. That is, research groups in education used videodisc to develop effective interactive instructional programs. This innovation was adopted by the government for practical application in the military. Industry then adapted the programs for commercial training. The consumer market made a natural shift from one form of audio/visual capability to another, because of videodisc's ease of

reproduction, cost effectiveness, transportability, durability and random accessability. In addition, the consumer demand contributed volume and visibility to the videodisc industry, which justified higher production runs of hardware and software. Expanded production in turn brought costs down and essentially insured the survival of the industry.

While consumer market demands may take credit for lower costs and higher productivity, the industrial training market's demand for higher quality has resulted in substantial improvement in the quality of videodiscs produced. Lack of quality control in the past has resulted in videodiscs which showed graininess, snow, washed out color, fluttering images, crackling high frequency squeals and audio "glitches". These "distractions" are believed to be caused by dust particles contaminating the reflective layer of the disc under the protective plastic coating or scratches or fingerprints on the protective layer of the disc. The presence of any of these create noise in the system and cause information encoded on the disc to be missed or distorted upon playback. Videodiscs currently being produced show a marked improvement in quality over those of several years ago. The symbiotic relationship of the various market segments is not aparent to the new observer of the videodisc industry. An experienced observer who is familiar with the historical development of the industry knows, however, that events in one market segment influence events in all other segments. An example of this interdependence is the impact recent use of videodisc players in arcade game consoles has had on hardware available to the industrial training market, costs, player design and so on. A

number of writers have chosen to portray competition among the various videodisc formats as "war", headlining their articles with questions of which format will win. The opposite appears closer to current reality: what benefits one format, or segment of the market place, appears to benefit all formats and market segments.

With most new developments, start-up phases are shaky and, for a period of time, there is considerable uncertainty whether the development will succeed. The interactive videodisc has apparently survived start-up and is now entering a phase of rapid expansion and adoption as a maturing new technology. More an more very large businesses are adopting interactive training as a means of cutting the costs of training, and at the same time realising increased achievement. The firms who were early to adopt interactive videodisc based instruction see it as a way of providing high quality instruction at remote sites, thus reducing the need for bringing trainees to central training facilties. This feature is seen as a way of saving millions of dollars in travel, lodging, and other training related expense, with an actual gain in quality, accountability and control.

A HISTORICAL PERSPECTIVE

Much of what is written about the interactive videodisc infers it is a new innovation in audio/visual technology. Never-the-less, the idea was conceived as early as 1880 by a German, Paul Lupkow, who received a patent for a "videodisc" the following year. In 1882, Alexander Graham Bell recorded sound onto a disc using an optical process. And in this century, in 1927 John Logie Baird, a Scotsman and early pioneer in the development of television reintroduced videodisc technology. By engraving video signals onto the surface of a phonograph record, Baird was able to record and play video images from the disc. He selected the futuristic name "Phonovision" to describe his wonderful new device. History recorded very little about Baird's marketing attempts. We have learned, however, that units were sold in a London department store for several months before the enterprise ended.

Little was done with the concept for more than twenty years. The next developmental milestone occurred in the 1950's, when Ampex Corporation, under the influence of Bing Crosby and John Mullen, introduced the first magnetic video tape recorder and developed the ability to modulate a video signal prior to recording. This allowed the signal to be recorded as a type of binary code. In 1956, Magnetic Video Recording introduced a magnetic disc for video recording of football plays for "instant replay". The machine provided slow motion, stop action and instant replay—all in

living color.

The 1950's heralded technological change and innovation: inventors and would-be marketers expressed renewed interest in the videodisc. Videodiscs were combined with music in a jukebox device called a "scopitone" where music played to a video accompaniment. The 25 cent fee for watching and listening proved too high for the cafe crowd, and the less expensive audio jukebox (5 cents a play) which required less maintenance forced the scopitone music box into retirement. (Recently an advertisement in the San Francisco Examiner's classified ad section offered an antique scopitone for sale for $6,000.00.)

Just before the 1972 Consumer Electronics Show in Chicago which was given the theme "Electronics 1985", Zenith created its first color videodisc. In Europe, AEG Telefunken disclosed similar interests in the technology, and reportedly held joint discussions with Matsushita. At that time all three companies projected a 1974 target for marketing a videodisc player. The same year, RCA announced tentative plans for marketing a videodisc system in the United States. Technologists who had been waiting to obtain a videodisc player were very pleased and anxiously marked the date.

By the mid 1970's, videodisc technology came into its own, but marketing decisions lagged. Finally, just when it seemed the developers' promises would never be made good, several companies in Europe and Japan

put their videodisc players on the market and teamed with American software providers to demonstrate the advantages of the new systems. In 1975 Telefunken, a German firm, and Decca, a British firm, joined ranks to produce a player which used a videodisc about the size of a 45 rpm phonograph. In 1978, Teldec successfully marketed the first videodisc system to appear on the market since Baird's efforts 50 years earlier. TelDec's system was presented in the form of a jukebox, holding as many as 50 of the small videodiscs, each of which could be selected for play. The TelDec system was discontinued in 1980.

Phillips, a Netherlands-based company, joined with Music Corporation of America to create an Optical Videodisc system in 1978. Phillips manufactured the player. MCA, through its Hollywood based Universal Studios, provided a library of film features and documentaries to be encoded for the disc. The Phillips player was distributed through Magnavox, a subsidiary of North American Phillips, in 1978. Later MCA developed its own Optical Videodisc division called Discovision.

In 1979, Japan's Matsushita introduced its "Visc" system, a capacitance-type player, which was discontinued in 1980.

Other companies which quickly joined the fray include Thomson-CSF Broadcast Inc., a French firm that developed a laser based player which was pilot marketed both at home and abroad; Sony Video Products Company, also an early entry to the fraternity of Videodisc manufacturers; U.S Pioneer

Electronics, one of the first to offer a laser player; and RCA, which entered the race with a capacitance consumer player.

A number of other firms who announced they would distribute videodisc players include Sanyo, Sansui, Quasar Company, Panasonic Company, JVC, Toshiba America, Inc., Sharp Consumer Electronics, Hitachi Sales Corporation of America and General Electric Company.

In a parallel development, a number ofcompanies have developed facilities to master videodiscs in commercial volume and quality. RCA and CBS Records both adopted a process to stamp out videodiscs in the capacitance electronic disc (CED) format. Pioneer, Sony and 3 M Company use an injection molding technique for mastering optical reflective laser discs (LV).

In 1974, i/o Metrics, demonstrated a system of encoding videodisc images using a photographic film to modulate the signal. The film-based disc was developed through a simple contact printing technique, and promised low cost, quick turn-around videodisc mastering. i/o Metrics went out of business, but the general concept was adopted by several other companies. ARDEV (no longer in existence), and McDonnell Douglas has since given demonstrations of its functional mastering capability using this type of process. Most recently, Laser Video, a Quixote-owned company, and Technidisc have entered the field of U.S. based videodisc manufacturers who's product will play on laser videodisc players.

The CED discs are manufactured much the same way as a traditional phonograph record. A liquid plastic or carbonized vinyl is stamped into a replica of a master copy. The liquid substance conforms to the condensed grooves from the mold (about 10,000 per inch). At the bottom of these grooves are microscopic indentations or pits. These pits vary in size and dimension, which gives each pit a different electronic value or capacitance. The CED player uses a fine diamond needle stylus to pass through the grooves of the videodisc. The videodisc conducts an electrical signal as the stylus passes over each pit; the stylus then relays that signal to the CED player. The player passes the electrical signal on to the monitor, where the information is tranformed into a video picture and is viewed by the user. The CED format is a simpler and less expensive means of producing disc copies. Because a needle physically rubs along in a groove to pick up encoded signals, however, CED is vulnerable to minute specs of dust, grease or other contaminants. For this reason, protective sleeves called "caddys" that resemble the cardboard jackets which protect audio phonograph records are provided with CED discs. The videodisc and jacket is inserted into the CED player and the jacket withdrawn. After being played, the disc is ejected from the player directly into its protective cover, eliminating exposure to the environment. The jacket cannot protect the disc from the wear and tear naturally occurring as the stylus travels through the grooves. Eventually, all CED videodiscs must be replaced. They are particularly at risk during the playing of a single still image, at which time the needle travels around the same groove again

and again 30 revolutions a second. A single frame can wear out before the other frames, causing a "skip" effect when the disc is played at its normal motion rate. CED videodiscs are also limited in their interactive search capabilities.

The optical reflective or LaserVision videodisc is better suited for still-frame and interactive applications and is preferred in the education and industrial training communities. Optical reflective videodiscs are classified as either Constant Linear Velocity (CLV) or Constant Angular Velocity (CAV). The CLV disc can store up to 60 minutes of linear programming per side, but when encoded in this format has only limited interactive capabilities. The CAV disc is more versatile for interactive programming, although its linear play capability is limited to 30 minutes per side. Four companies, Sony, Pioneer, Technidisc and 3M Company, use an injection molding technique to create optical reflective discs. Transparent plastic is injected into a glass mold sometimes called the "mother", which when ejected from the mold is seen as a transparent plastic disc containing millions of oval shaped microscopic pits. The pits vary in size and dimension and are arranged in circular "tracks" or "frames" around the disc. The discs are coated first with a reflective material and then covered with a protective coating of plastic. The layers are bonded together to produce a single sided disc. (Two single sided discs placed back-to-back form a double sided disc.) The final product resembles a shiny silver, 12" LP record. Though not recommended, the disc may be handled; its image is not damaged by dust or finger grease on the surface.

Therefore it is much easier to store and use than a CED disc.

One side of a videodisc may contain up to 54,000 frames (circular tracks) of information which might be viewed as single-frame images, text pages or linear motion sequences. Used in non-instructional applications, the disc may contain only digital data, and in this mode offers a tremendously dense computer storage medium. The technique of binary code storage first developed by Ampex now permits the storage of 1.25 billion bytes of read-only-memory per disc side, making the disc a very impressive data storage medium for computer applications.

Tim Onosko (1981) describes how the optical videodisc and LV player work together to produce a video image:

> The player's tiny laser (beam) is initially split into three components all moving together along an optical path, (the laser beam is passed) through a special optical element known as a Wollenston prism, and finally up to the surface of the disc. Two of the laser beams' three parts are used to track the disc, keeping the third centered on the pit containing the coded information. As the laser light is deflected by the pits passing beneath it, its polarity (the way light waves vibrate) is changed. The light is reflected back down from the disc along the same path until it again reaches the Wollenston prism, which is able to distinguish between light on its way to the disc and polarized light returning from it. The returning beams strike photo diodes which translate the impulses into signals processed by the player's electronics, transforming these signals into video and audio signals. (p.55).

The laser tracks the disc from the inside out (the opposite of the way a phonograph tracks records) as it spins at 1800 r.p.m., or 30 revolutions per second. This speed corresponds to the 30 frames per second of a

standard U.S. TV receiver. Thus, on a standard-play disc, each revolution of the disc provides sufficient data to create one frame of video.

The transmissive videodisc which has been developed for use on the Thompson-CSF player represents another type of optical videodisc system. The transmissive disc is transparent and in most cases is mastered like reflective videodiscs. The laser can be set to focus on either side of the transparent plastic disc, and thus can read pits on either side of the disc without turning the disc over. This gives the user access to twice as much material (108,000 frames) as is immediately available in the other formats. Thompson-CSF has been a reluctant entrant into the marketplace, but has shown the transmissive disc to be both a flexible and high quality alternative.

The Video High-Density (VHD) system combines the optical and CED formats. VHD videodisc players use a stylus that glides over the top of a non-grooved videodisc. The stylus is guided by "tracking" pits that run perpendicular to the information pits on the videodisc. The two signals (tracking and information) are picked up by an electrode located in the stylus sled. The tracking signal keeps the stylus on the correct frame, while the information signal is relayed through the player to the monitor for viewing. The VHD system has only recently been marketed in Japan and Europe by its manufacturer at the time of this writing and is not available in the United States, although a number of demonstrations have been given showing its capability.

INTERACTIVE VIDEODISC MANUFACTURERS

Systems

Supplier	Product Name	Contact
Allen Communications Salt Lake City, UT	TII System	(801) 537-7800
Bell & Howell Chicago, IL	AVA	(800) 323-4338
Digital Controls Norcross, GA	Learning Center	(404) 441-3332
Digital Equipment Corp. Maynard, MA	IVIS	(617) 493-7161
Digital Techniques Burlington, MA	TOUCHCOM	(617) 273-3495
ICS-Intext Westport, CT	Action Code	(813) 855-1934
Learning Link Corp. Salt Lake City, UT	Learning Link System	(801) 466-9276
SONY New York, NY	SMC-70G	(212) 371-5800
Technology for People Columbus, OH	Touch Me Vision	(614) 228-1928
Visage, Inc. Natick, MA	VDC-1000	(617) 655-1503
WICAT Systems Orem, UT	WICAT System	(801) 224-6400

Videodisc Players

Hitachi Chicago, IL	8500 & 9500	(312) 981-8989
Panasonic Secaucus, NJ	TQ series	(212) 348-7000
Phillips New York, NY	VP 832	(212) 607-3600
Pioneer Montvale, NJ	PR8210 & LD V series	(201) 573-1122
Sony Park Ridge, NJ	LDP-1000(A)	(201) 930-6432

MASTERING HOUSES
Optical Laser Disc

Pioneer Video, Inc.
Corporate Headquarters
200 West Grand Avenue
Montvale, NJ 07645
(201) 573-1122

Quixote
One E. Wacker Drive
Chicago, IL 60601
(312) 467 6755

Sony
One Sony Drive
Park Ridge, NJ 07656
(201) 930-6106

Spectra Image
540 N. Hollywood Way
Burbank, CA 91505
(818) 842-1111

Technidisc
2250 Meijer
Troy, MI 48084
(313) 435-7430

3M
Optical Recording Project
223-55 3M Center
St. Paul, MN 55144
(612) 733-4435

CHAPTER TWO

RESEARCH ON VIDEODISC INSTRUCTION

An exhaustive search of the literature related to interactive videodisc revealed an unruly body of information which may be characterized as eighty-five percent fluff and fifteen percent substance. Four distinct types of articles and reports appear in the literature: 1. Descriptive articles, citing capabilities of the videodisc; 2. Conceptual pieces, describing innovative ways in which the technology might be employed; 3. Pilot studies, explaining how the technology is being used with little or no evaluation data being presented; 4. Controlled validation studies, describing the results of research involving the use of interactive videodisc for instructional purposes.

Most of the descriptive literature tends to be over simple, redundant, erroneous and written with journalistic excess. The conceptual articles, pilot study reports and research findings proved to be the most useful and informative.

For the intelligent purposes of this report the authors found so

little quality information in the scholarly and not so scholarly literature that they called upon special contacts within the informal information network to obtain "fugitive" and other non-published documents to augment the very small stack of research literature. The information reported in this section is taken from all of these varied sources.

The information which follows will be reported within the structure of these categories: (1) Conceptual reports and experimental studies. Descriptive articles were used in writing the history and interactivity section of this report.

CONCEPTUAL REPORTS

Although the literature related to the development of videodisc technology has steadily grown since its inception, it was not until the mid 1970's that serious research began to appear in print conceptualizing how this interesting new hardware might be applied to instruction and training situations. Beginning perhaps with Bennion (1974), Winslow (1975), Bennion and Schneider (1975), and Schneider (1976), conceptual models of application of the technology began to be published. Each of these authors discussed the technical details of the various capacitance and optical reflective players and made economic arguments supporting the potential of videodisc when compared to video tape or film. (Estimates of the initial costs of interactive videodisc hardware were frequently only 20 percent of what equipment actually sold for when introduced on the market three years later). However the greatest contribution of the conceptual articles'

appeared in the form of instructional forecasts containing scenerios of potential educational usage.

Schneider (1976) describes a system (which at that time was being conceptualized at Brigham Young University) consisting of a small TV monitor, a videodisc player, a keyboard, a microprocessor and some "miscellaneous interconnection electronics". The system was to be used by learners at an individualized instructional station. He describes its proposed use:

> . . . individual lessons could be stamped out on . . . five minute videodiscs, that would have a magnetic band in the otherwise unused center. The student's identification number and the results of the test administered at the end of the lesson would be recorded on this band. The student would return the completed lesson disc to the school library, where the band would be read, the information would be fed to a central computer and the band erased for use by the next student. The computer would analyze test results, and compare them with previous test results. . . . The student's files would also be analyzed by the student's instructor to determine both individual and group performance on the learning materials. (p.57).

Schneider also wrote of prerequistes that would be imperative to the type of system proposed:

> Implementing these kinds of systems will not be a matter of simply waiting for the hardware. The major feasibility questions do not revolve around the videodisc technology, but around a still-infant instructional technology. . . . acceptance will not occur unless the material stamped on the disc really works, and works well. And it's not likely to work well unless it was developed and tested by people who had a pretty good idea of how to do the job right the first time. Unfortunately, instructional developers of such caliber are very few in number. . . .Until we have justifiable confidence in our instructional development procedures, we would do well to leave videodisc programming in the hands of the entertainment industry. (p.58)

Rodney Daynes (1976) performed a Delphi Study for the Navy Personnel Research and Development Center to forecast the potential impact of videodisc technology on Navy training until 1986. Fifty "experts" representing the corporate world, education, electrical engineering and media practice responded to 151 predictive statements in the final round of the study. Although concensus was reached by this panel on only 47 percent of the statements, they were in high agreement on the following issues related to instruction:

1. Elimination in the marketplace will bring about standardization of videodisc formats.

2. Videodisc will facilitate increased learning, provided educators are willing to embrace the technology.

3. The educational use of videodisc will lag behind its availability.

4. Videodisc will facilitate the growth of open learning, instruction to non-traditional learners, instruction for the handicappped, individualized instruction, and non-linear instructional design.

5. Overall use of interactive branching and fast random accessing of an audiovisual data base will increase.

6. Videodisc satisfies the requirements of a multimedia electronic environment of interactivity, individualization, individual frame addressability and random accessability.

7. Videodisc would create an instructional delivery capability characterizied by: sustantially more information storage at lower costs, longer operating life, reduced downtime and subsequently decreased instruction costs.

Based on the results of this study, Daynes recommended that the Navy should increase research and development investments to investigate the relative effectiveness of various media and to develop a methodology that

accounts for learning differences in individuals and provides optimal media combinations. Daynes argued the new medium offered sufficient potential and the survey respondents expressed sufficient agreement that videodisc would play a major role in a variety of learning and non-learning environments in the future to warrant immediate investigation.

A progress report published by Daynes and Nugent (1980) described the Nebraska Videodisc Project which was funded through a Corporation for Public Broadcasting grant. Phase I (equipment purchase and scheduling demonstrations) had been completed, and Phase II had been designed. Phase II would fund further investigation of the potential of videodisc for public and instructional television; continue market research; design, develop and evaluate pilot programs to demonstrate the unique characteristics of videodisc for educational uses; and expand the number of demonstrations of videodisc technology for public and instructional television administrators, staff and other representatives of the public educational sector. In the progress report, typical videodisc system capabilities were classified into levels one, two, and three (now used standardly throughout the industry):

> Level one, a videodisc player which possesses no memory and has no processing power (consumer players).
>
> Level two, an educational/industrial videodisc player with built-in programmable memory (1023 bytes)
>
> Level three, an educational/industrial videodisc player interfaced with a microcomputer (48k bytes).
>
> (There is currently much talk of level four and level five videodisc systems, text over video, sound over still

features prompting the creation of new levels, however, many of the recognized leading designers, including Rodney Daynes, are resisting this mindless convention of adding a level with each roll-out of a new feature).

One of the objectives of the project was to develop instructional videodisc programs for a variety of targeted audiences using the three levels of videodisc capability. Seven instructional strategies were authored and used in different combinations on the programs designed. They included:

Learner orientation to the program.

Dynamic instructional content.

Decision frames.

Comment on learning strategies.

Testing.

Help or learner assistance.

Summary.

The discs designed as a result of Phase II of this project have been demonstrated at numerous conferences, including the several Videodisc symposiums held in Lincoln, Nebraska which have been attended by a variety of training personnel from education, the military and industry. Disc titles include: Going Metric (level 1), Basic Tumbling Skills (level 2), Spanish Pronunciation (level 2), Principles of Operant Conditioning (level 3). The report confirmed what individuals working in development of this new technology could readily observe: The Nebraska team was doing an exceptional job in conceptualizing, developing and dissemination new interactive videodisc concepts.

Other publications by members of the Nebraska Videodisc Design/Production (NVDP) Group have disseminated important conceptual research. Ron Nugent (April, 1980) explored the problem of "interfield flicker" on single-frame edits. Standards for video levels (80 units and saturated backgrounds of 40 units) were also presented. Christie (1980) described the NVDP Group's design and production process which was used with its Media Development Project for the Hearing Impaired.

The contention that video would be an impressive new instructional technology in the future was underscored by Winslow (1974) who pointed out the flexibility of the technology and suggested new instructional strategies that would come as a result of its use:

> If you are a program designer who plans to use the videodisc as an instruction and training medium, you start with a "budget" of 54,000 frames, and you can employ them in whatever mix of still and motion sequences you think will get the job done most effectively. No more fooling around with a closet-full of unrelated and uncoordinated slides, film, and tape hardware. You will be able to do it all on one medium. (p. 21).

The World Institute for Computer Assisted Teaching (WICAT reported its interest in studying ways to apply computers to the solution of information and instructional problems to a Utah newspaper reporter (Deseret News, 1978). WICAT, based in Orem, Utah, directed by Dustin Heuston and Victor Bunderson, created what its directors claim to be the "world's first educational videodisc" under a contract with McGraw-Hill Publishers. By interfacing a computer to the videodisc player, WICAT combined three

important instructional tools: book, film, and computer (Bunderson, 1979). Bunderson also described instructional strategies WICAT was investigating through the McGraw-Hill contract and other contracts held with the Naval Personnel Research and Development Center, the Army Communicative Technolgy Office, the Army Research Institute, the National Institute of Education and the National Science Foundation. Two important issues inherent in videodisc strategy emerged:

1. The amount of processing intelligence required for interactive training.

2. The degree of learner sequencing control.

In projects like the McGraw-Hill contract, Bunderson employed consumer model videodisc players which give learners very little processing intelligence, but a great deal of sequencing control. Known as the "manual videodisc", this system used strategies adapted from the TICCIT CAI system, which offered the user quick access to survey tactics to skim indexes, tables of contents, chapter headings and pages; to understand the disc structure; and then to go back to information they wished to learn. Special management and orientation strategies helped the learners in this mode to know where they were in the data base, how they were progressing and at what level of generality they were working. Other contracts allowed investigation of the industrial player interfaced to a computer. These studies offered learners a greater amount of processing intelligence, but less sequencing control over the data base. Known as "intelligent videodisc", this system provided dynamic instruction going well beyond simple branching to sophisticated tutorial, drill and practice, simulation

and gaming and automated information retrieval applications. Further, this system allowed for advisement and coaching programs, scoring, record keeping, and information management options. The distinction was clearly understood by Bennion (1979) who expanded the concept to indicate that courseware should be designed to give learners meaningful experiences based on research on student responses and behaviors from other interactive systems such as TICCIT, arcade games and other modes requiring frequent input or answers from students.

WICAT reported the use of the Instructional Systems Development (ISD) design model on these projects to be both feasible and cost effective.

Bunderson (1982) predicted that through the use of laser and computer technology, significant increases in learner productivity could be achieved. He claimed learners would be spending more time on-task, would be receiving many more trials with feedback, and would be much more motivated and stimulated than through current methods. Bunderson added:

> . . . work sampling data on education productivity in the public schools have shown that, in a six-hour elementary school day, the average teacher spends only about 126 minutes on instruction. Of that amount, less than one minute a day is occupied in providing interactive trials and feedback with individual students. (1982, p.).

Bunderson believes that through increased use of technology, teachers may turn much of the information delivery and trial and feedback role to interactive computer video systems, and greatly improve the person-to-person contact with learners, individually and in small groups.

Michael DeBloois (1979) added to the growing body of literature conceptualizing the use of videodisc for instruction through his exploration of new design models. He argued:

> . . . it makes sense to examine our present assumptions about the hard and soft sides of technology, and to develop new and imaginative design models that will allow us to get out ahead of the surge and make it possible to derive the greatest benefit from instructional technology as it emerges. (p.34).

He went on to describe the need for new instructional design models:

> Instructional designers have probably found much comfort in the present models, (which) have been very useful in helping identify critical variables of instruction. With the pressure of recent hardware technology, however, it is becoming increasingly apparent that our models of the past decade no longer represent adequately the reality they are designed to simulate. Models that were useful for linear instructional development for a homogenous audience may no longer be useful for non-linear, interactive applications with varied audiences. Attempts to design instructional materials that use the full capabilites of an intelligent microcomputer/videodisc system demonstrate this divergence rather convincingly. . . Our current models no longer fulfill the requirement of representing all of the structural parts, processes elements and possibilities available, and if we persist in using them, we may very well hamper future instructional theorization. (p. 35).

DeBloois (1982) compared the assumptions underlying much of the current instructional design with those assumptions proposed for new approaches:

COMPARISON OF INSTRUCTIONAL DESIGN ASSUMPTIONS

CURRENT ASSUMPTIONS	PROBABLE NEW ASSUMPTIONS
1. Linear development of materials and strategies.	1. Mosiac/multi-demensional development of materials.

2. Homogeneous audience planning.	2. Heterogeneous audience planning.
3. Sequential component development.	3. Interfacing cluster development.
4. One time selection of material and format.	4. Multiple & continuing options for materials & formats.
5. Dominant media emphasis.	5 Eclectic media options.
6. Limited validation cycles.	6. Unlimited validation cycles.
7. Seperation of resource and presentation materials.	7. Integration of resource and presentation materials.
8. Limited dissemination capacity.	8. Extended dissemination capacity.

This article stops short of presenting a new instructional design model, offering as justification the newness of the emerging technology and the need for a new theory base. Planning strategies and functional worksheets are given as an intermediate assist.

Woolley (1979), Willis (1979), Smellie (1979), Thorkildson (1979) and Wood (1979) all of Utah State University, and Bennion (1979) describe their experience in formatting an interactive videodisc. These "how to" suggestions gave other experimenters the opportunity to build upon the knowledge of early developmental projects, thus shortening the learning curve and providing cost and time savings through learning from the success and mistakes of others.

Thorkildsen (1979) described early use of the interactive videodisc player (Microcomputer/videodisc system, MCVD) with handicapped learners. The "Matching sizes, shapes and colors program" used a puppet on the videodisc as a behavior model for handicapped students, with instant feedback, both from the puppet and other visual and audio sources. Future plans called for field testing the program on a population of handicapped learners. Thomas (1981) later interviewed Thorkildsen. He described other interactive programs his team had designed for handicapped learners: a time telling lesson, identification of coins and functional words. Two programs, directional propositions and beginning reading, were described as being in a planning stage. One of the major objectives of this program, called the IVSET Program, is to develop a set of computer programs that could be used as a general purpose authoring system for microcomputer-controlled videodisc courseware development.

EXPERIMENTAL STUDIES

Much of the early use of interactive videodisc for training and marketing began with individuals attempting to describe and conceptualize the technology. Secondary efforts have frequently taken the form of purchasing and integrating the hardware components into a workable system and developing and pilot testing software programs with a population of targeted learners or users.

Members of the Army Research Institute at Fort Benning, Georgia, performed a pilot study of videodisc effectiveness early in 1978 by comparing performance results of soldiers learning on a Bessler Cue/See system with performance results of soldiers using identical lessons on videodisc players. Prototype videodisc players were made available by MCA and Thompson-CSA for use in the study. Three sets of Army Training Extension lessons (TEC lessons) were selected for use on the Bessler Cue/See system. Identical content was pressed onto videodisc to be presented exactly as the Bessler Cue/See lesson, but using a videodisc player. Slightly modified content (visual frames added to the lesson at predetermined "stop points", which allowed the viewer the option of reviewing previous content or proceeding on with the lesson) was pressed onto a second videodisc version. The second version was added to allow random access to lesson content, albeit very limited.

Holmgren, Dyer, Hilligos, and Heller (1979) report two hundred and ninety-eight soldiers completed the training. Results showed no significant difference in learning among soldiers in the two videodisc versions. Significant differences were observed at the .05 level in a comparison of the Bessler Cue/See method and the combined videodisc methods, favoring the Bessler Cue/See training. Significant results at the .001 level favoring all three experimental conditions were observed when scores were compared to baseline data. The discussion of the study disclosed a very limited use of the review option by soldiers assigned to

the modified videodisc group, as well as a learning station set-up with placement of the monitor more than five feet away from the learner. (Bessler Cue/See screens were within 20 inches of the learner.)

The study was limited in scope, and from this author's point of view, attempted to find significant gains in a weak and poorly used videodisc application. Yet, one must recognize that in the first pilot study of the effectiveness of interactive videodisc training methods out the gate, the new medium ran less well than the existing training approach.

An undated SONY news release (Steven Cody) reported the use of more than 4,000 SONY LDP Videodisc players in Ford and Lincoln-Mercury dealership and company offices. Informal testimonials from sales managers throughout the training network reported the system to be "the best tool yet for training new people on products and the sales process. The density of the medium and the self-paced approach, which allows users to review segments, were described as very powerful features. Jim Miller, Ford division training and communications manager, reported that while the system could be improved, the videodisc network had already had a positive effect on sales and sales training.

Two scientists from the N.V. Phillips' Gloeilampenfabrieken Research Laboratories (Andriessen and Kroon, 1980), were interested in the educational effectiveness of interactive videodisc. Using a modified Phillips VLP videodisc player, a Phillips P857 microcomputer, a

videomonitor, and a learner control keypad, they tested the system with 12 subjects. The subjects spent an average of 55 minutes interacting with a videodisc lesson "Work of the Heart", an Encyclopedia Brittanica film which, along with about 100 still frame textvisuals on the topic were converted to videodisc. (The range of time spent on the lessons was 26 minutes to two hours). Subjects were observed to interrupt the film several times to look at a text frame or to make notes. At the conclusion of the exercise, subjects also chose to view questions and exercises on text frames. Here the questions which related to text frames were most correctly answered. A post-exercise interview found that the subjects enjoyed (1). the personal control of the materials, (2). the ability to repeat segments, (3). jumping through the material, (4). "easy rewinding". Several subjects did not like studying the material without social interaction with other students or teachers. The researchers built this feature into subsequent research with successful results.

DeBloois and Woolley (1981) report on a project developed by The Center for Instructional Product Development (CIPD) of Utah State University where interactive videodisc training materials were developed under a USAREUR contract. The Army MOS 63 C, "Troubleshooting Charging Systems Problems on Tracked and Non-tracked Vehicles", was selected for lesson development. Seventeen different lessons of a complex learning hierarchy were developed and subsequently pressed on a videodisc. Within each lesson, three different instructional tracks were designed using the branching capability of the medium. The lessons addressed the

instructional needs of novice, intermediate and advanced learners.

During June through August, 1980, three of the prepared lessons were field-tested in Mannheim, Germany. A Cromenco Microcomputer, keyboard and CRT, a DVA Model 7820 videodisc player, an interface device developed by Online Computer Systems Inc. and a 24" Sony Trinitron Receiver were installed in a basement training center at the army base. Subjects were scheduled into the learning center at 90 minute intervals. Upon their arrival they were asked to take a seat at the learning station and begin the lesson by pressing the return key on the terminal. All future instruction was guided by the interactive program. Subjects encountered a 20 item pretest which served as a diagnostic means for the computer to assign them to one of three instructional tracks. As students proceeded through the various lesson components, as many as four additional instructional quizzes were given and used to re-assign the learner to more or less advanced instructional tracks, based on quiz performance. Spanish speaking soldiers were offered a spanish audio track during instruction in lesson one.

Instructional cues were presented in a variety of forms: computer text screens, sometimes supported by audio from the videodisc; motion video with audio; still frame video with computer text support; audio, and audio-visual reinforcement for answers given, etc.

Viewed as a pilot test, a simple pre/post test design was implemented.

Thirty-four usable scores were obtained from thirty-nine subjects who completed the lessons. Initially subjects scored a mean of 9.2 on the 20 item pre-test, with a range of 2 to 15. The median score was 8.5 (SD= 3.7). On an identical post-test, administered after subjects completed instruction, a mean of 18.3 was recorded, with a range of 13 to 20 (SD= 1.83). The median score was 16.5 and the mode score was 20.

Students gained 9.1 points on the post test after having completed the three lessons, which proved significant on a t test at the .001 level.

Perhaps more important than the student performance data were the results of exit interviews. Here students reported: they enjoyed the lessons (97%), the lessons were very effective (83%), computer and videodisc were very dependable (91%), pace of learning was appropriate (91%) and the level (sophistication) of the training was appropriate (94%).

Nearly 80% of the subjects considered the use of visuals and audio from the videodisc to be essential to their learning, and they rated the humorous and serious reinforcement given them from the videodisc as most successful and enjoyable.

Students were critical of a lack of or poor instructions in the use of the keyboard, they found some visuals on the videodisc to be poor in quality, and they were critical of bugs in the computer software which occasionally occurred as a result of hastily prepared programming due to

insufficient preparation time and unavailability of computer equipment selected by the army.

The findings of the pilot study pointed optimistically to the potential effectiveness and acceptability of interactive videodisc instruction among soldiers . The authors pleaded for future studies where control could be maintained in: adoption of a more sophisticated evaluation design; selection of sample subjects; creation of equivalent treatments; assurance of greater development time; and procurement of a stable power supply for the equipment.

"Can a videodisc and computer make life any easier for art historians and others who want to extract information from a library of a quarter million or more pictures?" This is the research question asked by Dr. Joan Sustik (1981) of the University of Iowa in a pilot study performed in December 1980. One thousand black and white photographs taken from the 21,000 image Bartsch collection held in the Iowa State Art and Art History collection were pressed on a Thompson-CSF videodisc. The Thompson-CSF TTV-3620 videodisc player was interfaced with a HP 2000 computer. An Apple II was used as a link and terminal, and a Sanyo B/W monitor was used as a display device.

Three faculty members, three staff and ten graduate students served as subjects. Results showed that all subjects would use the system again if it were available. Approximately two thirds of the subjects responded the

system was above average in usefulness, was easy to use, and offered speed in retrieval. Eighty percent of the users agreed that the videodisc system had strong research potential. On the other hand, eighty percent of the users found the instructions for system use unclear, and the same percentage preferred displaying pictures in lecture rooms using traditional slides and projector. User responses to a semantic differential suggested a slightly positive attitude toward the videodisc system.

Sustik discused a number of weaknesses in the study, including: poor image quality, inability of users to compare two images simultaneously, (images could be viewed one at a time in a sequence on the single screen), frustrating delays on some individual searches, and use of too small a display monitor. Sustik concluded with the observation: ". . . the system, though viewed critically, was viewed favorable, subject to improvements and modifications." (p.13).

"People are extremely accurate in remembering pictorial information" quotes Kristina Hooper, in her study entitled "The Use of Computer-controlled Video Disks in the Study of Spatial Learning". (Hooper, 1981, p. 78). Hooper's work helps demonstrate the great potential interactive videodisc technology has for supporting research in visual information processing and cognitive mapping. Hooper, along with Robert Mohl observed eight individuals "explore" the town of Aspen, Colorado using the Massachusetts Institute of Technology system developed by Negroponte and Lippman. The study was based on the premise that ". . . interaction

with the system is equivalent to interaction with environments, and hence, that the study of system interaction is the same as direct study of environmental learning".

The observation of the subjects proved to be a positive evaluation of the disc system. In addition, the researchers learned a great deal about how individuals learn places. The findings also have a great deal of importance for using these systems in any learning environment.

Reporting her findings, Hooper says:

> . . . consistent with general concepts of learning, subjects initially moved about in a somewhat random fashion, learning only general features of the town. Then as they encountered familiar areas, they integrated their experiences and moved through the town in a more systematic fashion. In addition, subjects made a number of errors in their explorations that are consistent with other data on place learning. As examples, objects viewed first from one direction and then the other were frequently not recognized to be the same objects, and hence inaccurate parallel structures were derived and opportunities for integration were missed. Curves that took viewers to the right or left without their making a decision were frequently forgotten and inconsistent representations were then forged; representations were challenged and reconfigured only after a large number of inconsistencies were observed. (p. 83).

Hooper's report suggests that educational simulations which create a cognitive map of the topic to be learned, and which do it realistically and with fidelity, are likely to be treated by the learner as though it were the actual territory. Other studies reported here seem to point to the same suggestion. Of the Aspen disc study, Hooper goes on to say, "Another observation that provides assurance that the disk system is valuable in

studying spatial learning was that subjects engaged strategies much like those reported by individuals interviewed about how they learn places, strategies which are also consistent with general models of learning." (p.83).

The interactive videodisc, as seen in this study, is a tool in which high levels of control can be realized without sacrificing realism of display. It surpasses the capabilities of standard media, and when it comes to displaying complex materials, and goes well beyond available computer graphic systems. It is one of the new technologies which promises to facilitate psychological and educational research that to-date has been extremely difficult to approach.

The National Science Foundation suported WICAT with a grant to develop and evaluate an interactive videodisc system to experiment with equipment which would be "typical of center-stream hardware in the next five years." The course material was aimed at university level introductory biology, and included concept instruction, laboratory guides and simulations, micrograph files, vocabulary games, and drill and practice routines in scientific notation.

Results of the associated evaluation showed that students who used the interactive videodisc system scored significantly higher on a reliable post-test than students who received the instruction from classroom lecture and textbook. The average total study time required by the videodisc group

was 37% less than the time required by the classroom group. (Bunderson, Olsen, & Baillio, 1981).

WICAT also evaluated the HAWK Training System which used an intelligent videodisc system, in April and May of 1982 at the U.S. Army Air Defense School in Ft. Bliss, Texas (Gibbons et al., 1982). Guided by Army guidelines, WICAT personnel adopted a system consisting of a micro computer, a videodisc player and a hand held keypad. The training program contained instruction and two-dimensional simulations related to a number of weapon systems for use by maintenance and operator personnel. The purpose of the evaluation was to determine the ability of the system to provide soldiers instruction and realistic simulations. Three evaluation groups were used. The first consisted of sixteen students who were given normal classroom instruction followed by a post test. The second group, made up of ten students, was offered lessons using the HAWK Training System followed by a post test. Group three consisted of twenty students who were given both lessons and simulation problems followed by the post test.

The results of the evaluation showed only twenty-five percent of the students from group one were able to solve the test question at the completion of instruction. One hundred percent of the students from groups two and three were able to solve the test questions. In addition, the students in the third group were able to successfully solve the test question in half the average time of group two students, who, received no simulation problem during their instruction. The authors concluded the

interactive approach to instruction achieved their objective of adequately delivering instruction and that using computer and videodisc to create a realistic simulation had a pronounced improvement upon the students' efficiency at problem solving.

DeBloois and Wiggington developed an interactive videodisc Nutrition Education Program based on the Index of Nutritional Quality, the Daily Food Guide and the Dietary Guidelines for Americans, which was designed for use by high schools seniors or college freshmen. The lessons consisted of an hierarchial set of modules which (1) pretested students entry knowledge, (2) used an interactive branching program to teach the basic five food groups and the dietary guidelines, (3) presented instruction on using the Index of Nutritional Quality (4) provided video role models using the previous information in making food choices in college student settings (fast food restaurants) and (5) required learners to in-put their own food selections for a 24 hour period, analyze the nutrient profile of those choices, and make suggestions for more appropriate personal choices. A post-test was conducted along with an exit interview to provide pilot test data on the effectiveness of the system. Glenda Wigginton Edmonds (1983) reports that the majority of the seventeen college-age learners who completed the program felt they had increased their nutrition knowledge (29.9 percent strongly agree, 70.6 percent agree), and the information would help them make prudent food choices. Fifty-three percent strongly agreed, and 47 percent agreed the instruction was "at an appropriate level for their understanding." While the mean values of the nutrition text

scores in this pilot test did increase, they did not prove to be statistically significant. Thirty-five percent of the participants had scores of 80 percent or greater on the pre-test, which left little room for improvement. Edmunds suspected that many of the individuals who volunteered to complete the pilot test may have had previous nutrition instruction. Those participants who scored below 70 percent on the pre-test improved considerably after instruction.

Mike Bush reports a study at the Air Force Academy in which 20 cadets were given the opportunity to engage in German Language instruction, using a disc developed jointly by Utah State University, Brigham Young University, and the Goethe Institute, San Francisco, entitled "Klavier Im Haus". The disc was used in two formats, one which was strictly linear, exactly like a standard educational film, the other was an interactive version using Texas Instrument Microcomputers interfaced to the videodisc player. Bush reports achievement scores and personal preference feedback which favor the interactive treatment. (Bush, 1983).

Also researching the use of the technology in a language instruction area, Larrie Gale, (1983), of the McKay Institute, of Brigham Young University reports findings which favor interactive instruction. Gale established a control and experimental group of subjects, the former viewing a linear Spanish language videotape entitled Macario; and the latter receiving the same video footage, but in an interactive form from a computer interfaced videodisc player. The videodisc version was

inexpensively developed through the use of an annotation template which allows standard questions to be asked at key points in the film which relate to the story or themes of the film. The same computer template may be used to create an interactive exercise from any linear tape or film converted to videodisc.

The experimental group which used the interactive videodisc system scored significantly better (.01 level) on a 200 item multiple choice test than the control group who viewed the film but did not have an interactive experience with the material. The standard deviation was 1 1/4 SD, which means the worst experimental subject score was better than the average score for control group subjects. The achievement test attempted to measure ability in Spanish conversation and sensitivity to Mexican culture symbolism.

In the same year, DeBloois of Utah State University field tested a PLATO-interfaced videodisc training package entitled "Simulation Training in Agribusiness (SIMTAB)" to determine if videodisc instruction was as effective as traditional video, but non-interacive instruction; if learners perferred an interactive lesson and found it easier to use than a traditional lesson, and if interactive lessons took less time for learners to complete compared to non-interactive video lessons covering the same objectives. Forty small dairy farmers, from a population of 117 that fit the criteria from small diary farmers in Cache County, Utah were selected

to participate in the study. Twenty farmers were randomly assigned to a control group and twenty to an experimental group.

A mobile van was equipped with two learner stations and driven to the farm where participants received the instructional lessons and testing sequences. The control group station consisted of a videotape player, a 16 page workbook, and paper and pencils. the experimental group station consisted of a videodisc player, a PLATO terminal, and telephones and cords. Consistent with the objectives of the research project, two types of treatments were used: an interactive lesson delivered through a videodisc player interfaced with a computer; and a linear, non-interactive lesson delivered through a videotape player with an illustrated workbook. Each treatment held identical instructional objectives, and instruction concerning artificial insemination of dairy cattle was carried out on comparable video sequences for both learner groups.

The control group's lessons were controlled by the designer, learners were asked to stop the videotape machine and answer questions in the workbook at four predesignated points in the lesson. the experimental group, on the other hand, was frequently given the opportunity to select from among options, make decisions, and experience consequences as a result of those decisions. learners in this group could stop, repeat, or jump ahead. the dependent variable was interactivity. Pre- and post-tests were administered.

A statistically significant difference was found between experimental and control group scores. while the pre-test scores of the two groups were not significantly different, the post-test scores were. The experimental group, which competed the interactive lessons, achieved significantly beter scores on the post-test than did the control group. Both groups made learning gains as a result of instruction, but the experimental group gained more by using the interactive lesson.

In addition, an exit interview completed by all participants provided interesting comparisons. the experimental and control group subjects rated the instruction they received as being "all right" or "very good" (appproximately 50% each), and between 70 and 75 percent of the subjects of both groups indicated they learned something about artificial insemination. One hundred percent of the experimental group subjects rated the content as being well-defined, compared to 90 percent of the control group subjects. All of the experimental group respondents also said they would recommend the lesson to other farmers; 84 percent of the control group respondents made the same recommendation. Between 70 and 75 percent of all participants felt more comfortable with individualized instruction than they did with formal lessons from a teacher or extension agent. only ten percent felt less comfortable.

Eighty-five percent of the experimental group said they would attend this type of lesson again, compared to 58 percent of the control group's subjects. Eighty-five percent of the experimental subjects indicated they

believed the videodisc was an easier way of obtaining information than a book or film, 15 percent did not know. Ninety percent of the experimental subjects aid the system was time efficient. Learners from both groups showed anxiety and physical difficulty using the terminal keyboard. Less than 50 percent of all participants were willing to discuss weaknesses in the program, which ranged from too little audio, brievity, and neglect of some topics. Experimental subjects were much less critical than the control subjects.

To summarize, the experimental group, which used the interactive videodisc materials, scored significantly better on a post-test than the control group, which used linear video tape materials. in addition, the interactive videodisc users generally showed they were more positive about the experience, more willing to recommend it to other farmers, and discussed fewer weaknesses than the control group.

Observers of the field test saw the subjects in the interactive videodisc group generate a variety of different lessons based on their selections and witnessed considerably more intensity and active interest in the lesson than was displayed by the subjects in the control group.

Florida' Department of Health and Rehabiilitative Services (HRS) completed a 160 hour training program consisting of nine videodisc sides, 78 floppy discs and eight reference manuals designed for instructing aides in a public welfare agency. In 1983, thirteen candidates were selected to

be trained in a Fort Lauderdale facility on thirteen learning systems. The equipment consisted of a Pioneer 7820/3 videodisc player, an Apple II microcomputer, a Coloney VA-1 interface, and a Zenith/Heath color monitor.

The thirteen candidates completed the training experience in 60 to 194 hours, with the average completion time requiring 120 hours. This represents a 25% reduction of training time compared to conventional training. An analysis of how the thirteen subject's time was spend disclosed that 43% of the time was used reading computer text on the screen, 8% was spent viewing videodisc generated visuals, 30% of the training experience had subjects reading manuals and practice forms, 5% of the time was spent conferring with the trainer, and 14% was used on self initiated breaks.

The pilot test subjects scored an average of 83 percent on a final test, with a score of 70 required for a passing grade. After training had been concluded the 13 subjects attended a conventionally taught course on administering Food Stamps. All thirteen of the subjects reported they preferred the interactive training format.

Richard C. Smith, Director for the Office of Interactive Technology and Training at the University of West Florida, reports that during the 120 hours of training three videodisc players failed and required repair work, and two others could be used for only an hour or two at a time at which

time heat build up required they be temporarily shut down. One computer failed during the test.

Mr. J. M. Fitzsimmons, Assistant Manager for Training and Development for the Southern Pacific Transportation Company reports the results of training he conducted in a Railroad Yard office during the month of May, 1983.

Fifty railroad workers on the Port Terminal Railroad Association in Houston, Texas were trained on a computerized interactive videodisc system (CVI). Courseware material included information on Train Yard Safety, Blue Signal Placement, Air and Hand Brake Practices, Hazardous Material Handling, Employee Injuries, and Coupler Safety. Each course required approximately twenty minutes to complete. Video scenes were used to drive a set of questions, correct answers were acknowledged, incorrect answers looped the student into a video scene which presented correct procedures. At the conclusion of instruction video scenes were used as a reinforcing mechanism.

One hundred percent of the subjects responded favorably to the training. Over 90% reported the system easy to use. Eighty-five percent said that they would prefer a combination of CIV instruction with some classroom and on-the-job training.

Only one person reported difficulty in scheduling his training

session, underscoring the benefit of interactive training being used in remote locations in an on-demand schedule.

The railroad workers reported the CIV training to be an effective tool in increasing safety awareness. They found the keyboard to be a little cumbersome since many were not familiar with a typewriter keyboard. They were most positive about instructional segments rich in video sequences, that were to the point. Short, concise videotext displays were prefered over longer more difficult sentences.

The number of scientific studies performed to assess the effectiveness of interactive videodisc instruction is small. Many of the reports written to-date reflect a technology which is still in its beginning stages. Little money or time is being spent on evaluating just what benefits can be expected from interactive instruction. Many of the studies use inadequate research models, too few subjects to generate statistics of any power, non-randomized approaches, inadequate controls, and so on. Critics of these early projects will certainly point to validity and reliability problems with the data reported, and subsequent projects will devote greater time and money to an adequate assessment of the effectiveness of the systems.

All this not-with-standing, there is little doubt that early research suggests a number of general statements about interactive videodisc systems:

1. Interactive videodisc represents a new medium, unique from earlier approaches, containing the many strenghts, but fewer weaknesses of other media. It should be treated as distinct and seperate from either educational videotape or computer assisted forms of instruction.

2. New instructional design methods and models should be used to develop new types of instruction if the benefits of the new technology are to be realized.

3. Interactive videodisc instruction which is thoughtfully and systematically developed, and shows creative new instructional strategies is beginning to demonstrate consistent positive results.

4. Typically, learners who use interactive systems are achieving scores which are significantly higher than learners using other approaches. They often do this although they spend less time in instruction. Uniformly, these learners report they enjoy and prefer woking with interactive videodisc systems over conventional mediated approaches.

5. The concept has been proven, interactive videodisc lessons can be created, the equipment can be successfully integrated, and it stands up, (often better than other video systems) under thousands of hours of use.

During the writing of this report new research efforts have begun which, when completed, will do much to provide more substance to this growing body of research findings.

CHAPTER THREE

DESIGNING FOR THE ADULT LEARNER

Much research has been done over the past fifty years relative to the effectiveness of different media and media variables. These studies have focused on inceasing individual productiviy, meeting individual needs, increasing the quality of instruction, and developing optimum study environments. Lipson (1980) believes the effectiveness of a given format of instruction depends largely upon whether the designer has created a match between the characteristics of the message or instructional cue being delivered and the characteristics of the learner receiving the instruction. With interactive videodisc-based lessons, we have for the first time a technology that truly allows designers to match the message to the learner's characterisitcs and to require involvement by the learner in the lesson.

In order to match the needs of the learner, however, the designer has to identify salient learner characteristics, such as age, cultural attributes, previous education, expectations, etc. Although designers have long recognized the need to assess the target audience, they have not always been successful in meeting their audiences' needs. More and more programs are used by adult learners, for exampple, but instructors still

design programs based on what they have learned about and experienced in teaching children, adolescent, and college students (Andrews, et al. 1981). The American Society for Training and Development (ASTD) included understanding adult learning in the thirty-one most needed competencies for the instructional designer/trainer (Mclagan and Bedrick, 1983). Experiences in instructing younger learners may not apply to adult learning situations; the instructional designer must recognize how the two groups differ to design instruction that will be effective for adults.

THE LEARNING PROCESS

Adults carry their past experiences into the learning process, and these phases of development must be recognized. Differences in physical and sensory capacity; self-image and role in life; cognitive and intellectua capacity; and orientation toward learning will distinguish adult learners from younger learners and will require special attention from the designer when planning programs aimed at adults.

Physical And Sensory Capacity

Many of the adult learner's needs are dictated by physical and sensory changes that occur later in life. Slowing of reaction time, changes in weight distribution, importance of surroundings, and changes in health all affect how the adult learns. A person's reaction time peaks at about age twenty and then by age fifty slows to about the level it had been at age

fifteen (Knox, 1977). Knox attributes the reduction in speed to the loss of "signal strength" (the electrical impulses in the nervous system) from the reduction of cells in the nervous system, causing "neural noise" or impedance. Kidd (1977) indicates that the slowing of reaction time is evident in a person's abiltiy to react to sounds: Adults not only experience loss of hearing as they grow older, they are also slower to hear. Weight distribution also changes. As a result, individuals become uncomfortable if they must sit or stay in one place for long periods of time. Adults also become uncomfortable if their surroundings do not make them feel at ease. They need good ventilation, plenty of space, a pleasant atmosphere, an appropriate seating arrangement, etc. (Burnham, 1984). In addition, to these factors, infirmities such as loss of vision and hearing may be encountered more frequently when training the older learner.

Each of these physical and sensory factors has to be considered as the designer plans a program. Knox (1977) reports that adults compensate for slower reaction time by increasing attentiveness and accuracy. When dealing with older adults, the designer can allow more time for learners to compete tasks. The designer can also incorporate more breaks into a program, suggest the kind of environment most appropriate for adults, and allow for infirmities such as reduction in hearing or sight. The designer could provide options such as allowing the learner to choose between text or audio messages, or both, normal sized or double sized text. The volume of the audio could also be made adjustable by the learner. The input device (keyboard, touchscreen, light pen, etc.) used in an interactive system

could be adjusted to accommodate individuals with handicaps. Not handling physical and sensory problems properly can have a negative influence on the individuals performance, self-image and motivation.

Self Image And Role in Life

The adult leaner's self-image and role in life are equally important in determining how that learner will react to the learning experience. The designer has to consider the affective domain--feelings and emotions--when dealing with adult leaners. Kidd (1977) points out than any learner, child or adult, brings feelings of self-esteem, fear, jealousy, respect for authority, and so on to the learning situation; those needs and motivations are primarily emotional, not intellectual. The adult will be more likely to ask: "What do I get out of it?" Most often, adults are voluntary leaners. If they do not feel the need for learning, they will block out the stimuli and think about problems they feel are more important. Acceptance of the instructional delivery will result in feedback and inquiry about the subject, whereas rejection of the delivery will terminate a learning situation as surely as if there had been no instruction (Burnham, 1984).

Adults bring a great deal of ego to a new learning situation. Knowles (1978) noted that ". . .as a person grows and matures, his self-concept moves from one of total dependency (as is the reality of the infant) to one of increasing self-directedness" (p.55). The adult prefers to have more

control over the learning situation than would a child. Designers need to establish some relationship between the learning situation and the learner's concept of self. Kidd (1977) observed that new learning experiences "are symbolized and organized into some relationship of self, or are ignored because there is no percieved relationship, or are denied organization, or given a distorted meaning because the experience seems inconsistent with the stucture of self" (p.130). When lerners perceive that a situation is too risky, they will become defensive, and the learning experience will be stifled (Burnham, 1984).

The learner's self-image may change as his or her role in life changes. Experience is to learn first-hand. Naturally, adults have had greater opportunity for this type of learning than have children. An adult also learns vicariously from the experiences of others more readily that does a child because an adult has more experiences to compare and associate with than a child has. Such associations positively reinforce the adult's perception of leaning from his or her environment (Donaldson and Scannell, 1978). Generalized assumptions about how people learn over the lifespan can help the instructional designer develop instruction that is appplicable to the characteristics common to adults that will be involved in the training experience.

Cognitive And Intellectual Capacity

Understanding cognition can help the designer understand how peole

learn over the lifespan. An individual's cognitive capacity is his or her ability to acquire knowledge. Many processes are involved, according to Craig (1976), including perception, memory, problem solving, and the relating of one piece to another. Craig also lists generating hypotheses, analysis, synthesis, and inductive and deductive reasoning as examples of cognitive proceses. She indicates that cognitive development among adults "tends to be less dramatic and more diverse than childhood development, because adult cognition is much less a function of maturational complexity and much more a function of life experience" (p.67).

Cognitive development is analogous to the growth of a tree. A young tree's growth focuses on vertical development of the trunk. As the tree matures the trunk broadens and offers sustenance to the branches. Eventually the trunk and larger branches appear to have stopped growing, yet the minute twigs and smaller branches are continually developing. Likewise, an adult appears to be fully grown, but is continually expanding his or her mind, reaching more and more intricate levels of knowledge.

Instructional designers must understand how adults process information and design programs accordingly. Well designed training materials will allow learners to grasp new concepts quickly, relate them to past experience and knowledge, and retain them in memory for later application. Memory consists of networks of prior knowledge that needs to be tapped during instruction. For deeper information processing to occur, the learner has to be actively involved in the learning experience, and new

memory networks have to be established.

The learner processes information through four stages of memory: sensory, short-term, long-term/shallow processing, and long-term/deep processing. Good spatial arrangement, such as effective layout of text and graphics and use of logical subgroupings, assists in sensory memorization. Pictorial cues, including color coding, arrows, drawings of key items, etc., enhance short-term memory. Verbal cues that support these visuals also help the learner with short-term memorization. Long-term/shallow processing memorization can be encouraged by using rehearsal, mnemonics, imaging, and paraphrasing, while long-term/deep processing memorization can be enhanced by using assimilation and analogical reasoning.

Other ways to incorporate how adults process information include dividing topics into understandable subtopics, using feedback effectively, and increasing retention by having learners explain, paraphrase, and converse. When topics are divided into subtopics, they become more manageable, and they help make a program more interactive. Each subtopic cannot be packed with too much information. Adult learners need pauses to process the information they have just received. Designers can incorporate visual or audio relief, ask questions, or stop on still frames to provide the necessary pauses.

Unlike common practice, research shows delayed feedback may be more effective when dealing with adults. Delaying feedback produces the same

amount of leaning, but results in increased retention rates. Any feedback must be meaningful to the adult learner—explaning, as well as praising or correcting.

Adult information processing is also enhanced when the learner explains, paraphrases, or discusses the information presented. By putting the information into his or her own words, the adult digests the material and is able to retain it longer. Of course, this is easier to do when working in a group. The designer of individualized materials must have the learner simulate this experience. This can be done by allowing the learner to choose between explanations or descriptions imbedded in the program, or through the use of surogate discussion partners that anticipate discusion points, or by asking learners to leave the system and deal with the concepts just learned, by constructing a model, drawing a diagram or something else requiring their internalizating of the topic.

Orientation Toward Learning

Just as adults process information differently from children, they also change their orientation toward learning. Individuals move from being subject-oriented to being problem-oriented as they grow older. In school, children are motivated by external pressures from peers, parents, teachers, and others to study and attend class (Knowles) 1975). In a training situation, adults are motivated by knowing that the training will in some way help them overcome problems, in their jobs or lives. There must be

some transfer of the instruction to the real world for the training to be considered effective by the adult (Donaldson and Scannell, 1978). Participants must be ready to learn. according to Donaldson and Scannell, "Unless there is an innate motivation and an acknowledged readiness on the part of the learner, even the most articulate, elequent presentation will not fulfill its goals" (p.57) They stress that participants need to be told why they are learning each subject, so learners can recognize the lesson's value and prepare themselves for learning.

Adults not only want to know why they are required to learn about a subject, they also want to have input into the learning experience. They accept more responsibility for the learning act than do younger learners.

If instructional designers would attempt to meet the needs of the mature learner, by creating lesson materials which capitalize upon the characteristics mentioned in this chapter major progress could be realized. In addition to that, if they could also create the kinds of new opportunities seen with interactive training, through the use of computers and videodiscs, a remarkable advancement in training technology might be made. We would undoubtedly see improved achievement, greater retention, and better attitudes toward learning among this group.

Because of its storage and branching capabilities, the interactive videodisc makes it possible to have many tracks of instruction, each suited to the characteristics of different learner groups, all on one program.

The more that is known about the learner, the more tailored the program can become.

CHAPTER FOUR

POTENTIAL OF INTERACTIVE INSTRUCTION

Interactive videodisc systems are being used for training and instruction. However they are yet too new and untried to speculate broadly about their potential. This report has shown interesting trends which may point the direction of the future.

Certainly use of the medium conforms with principles of learning theory and message design. The evidence to date does suggest that from the theoretical point of view, at least, this new medium has more promise than many others which have come before.

The results of numerous conceptual articles indicate a rich and growing body of interesting applications of the technology in training and instruction and in public information applications. The advent of interactive videodisc seems to have captured the imagination of educators and entrepreneurs alike.

Recent studies have shown favorable results for the videodisc technology. Learners are reporting they favor the individualized interactive approach over teacher-controlled instruction for some subjects. An emerging trend indicates the combination of computer and

videodisc is much prefered over other interactive approaches, including stand alone computer lessons or computer interfaced videotape lessons. Learners enjoy the opportunity to interact with instructional segments encoded on the optical and magnetic discs to create a lesson sequence which matches their preferred style, pace and sequence for learning. The data are accumulating to indicate this form of instruction produces more learning than other approaches and that end-of-lesson objectives are achieved in less time. There are indications that, once sufficient courseware is created and distributed to enough consumers, videodisc-based instruction will be less expensive than other forms of instruction, including stand-up lectures by live teachers. While no one expects learners to request a steady diet of one-on-one instruction with a videodisc system, at the expense of interaction with peers and teachers, there is considerable evidence that learners enjoy learning with the interactive videodisc system, and may opt for this type of instruction for well-defined performance-based learning tasks.

At one time many early critics of interactive instruction discounted its potential because of prohibitive costs of equipment and courseware development. The read-only format of the videodisc also was regarded as reason for caution. This has mostly been off-set by a steady decline in the cost of videodisc players and microprocessors. Player features which four years ago cost $3,500.00 are now surpassed by equipment costing under $1,000.00. Microcomputers and other microprocessor controller-type devices are available at similiar reductions. With the growing number of

instructional designers who have worked with the medium, the development of authoring systems, planning techniques and templets, sophisticated learning systems are being offered at a fraction of the cost of early research projects. The fear of prohibitively expensive hardware and courseware is no longer a valid barrier to development.

A new generation of options are waiting for adoption. Waiting for the costs of first generation technology to be paid-back. Waiting for the installed base of equipment to grow to sufficient size to warrant further development. Waiting for courseware needs to create a demand for greater capability. The erasable videodisc has been demonstrated as feasible. The local production and pressing of videodiscs is likewise a proven technology. The use of sound over still-frames (up to 15 hours of audio on a single disc) is available from a number of vendors. Low cost transfer of 35 mm slides to videodisc is available. Sophisticated authoring stations which allow non-programmers to create interactive lessons can be purchased. Large screen projection equipment, flat screen equipment and portable point-of-training equipment, are ready for use as market conditions allow. Techniques are being developed to allow groups of learners to engage single interactive videodisc stations, using a form of group process, thereby increasing the number of learners who can be taught by a single interactive station at one time.

Obviously there are factors which may inhibit the future of interactive instruction, particularly in the public educational arena.

Shrinking budgets pose a problem to the adoption of any new technology. At all levels of education in the public schools there seems to be less money. There is little question that due to this shortage public education may very well be the last institution to become interested in interactive instruction as a education medium. Money is not the only problem. Using an individualized technology approach to meeting the learning needs of students goes counter to prevailing conventions of the one teacher/one classroom learning environment which has become so standard throughout the nation. The retraining of classroom teachers, to alter their expertise from dispensing information verbally to a homogeneous group of learners, to becoming information and instructional managers using a variety of technological assists which are appropriate for individual students will be slow and difficult.

Private enterprise has already shown it will lead the way in using new forms of training to assist in the continuing education of the adult work force. The factors which have created this dichotomy will provide parents of learners new alternatives to the public school. How will the public elementary school compete with a technology-based private learning center that can guarantee a child's performance in reading, writing and arithmetic, in half the time at half the costs? How can a public university compete with very large corporations in specific job-related training and instruction, when the latter has the money, the equipment, the technical know-how, and the will to create the most sophisticated interactive systems? In both instances, the answer is that public

educational agencies will not compete, and eventually will be forced to adopt new funding patterns, or more closely integrate with private enterprise to share resources and educational missions. Without significant adjustments which allow public educational institutions to join in this revolution and realize the benefits of technology-based instruction, there will be a noticeable acceleration in its rate of decline.

While this commentary on the future of interactive instruction is not intended to suggest that computers and videodiscs will turn the educational world on its head, the unmistakable fact is that a technological educational revolution is well underway that is unlikely to be turned back. The videodisc is being adopted as an important piece of technology within this revolution, and the possibilities it creates for more effective and efficient instruction leave little doubt it will flow, mid-channel with the larger technological phenomena.

The optical laser technology could take many forms: optical cards, digital cubes, vertically encoded discs and so on. Whatever particular form becomes market dominant, present trends seem to support the prediction that the instructional benefits produced by such systems, at such favorable costs, will insure continued interest in and adoption of interactive instruction.

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About The Videodisc Monitor

The Videodisc Monitor is a monthly news report of 20 or more pages dedicated to the videodisc industry. The Monitor focuses on non-consumer industrial and educational applications of the technology, and emphasizes new products and services, market statistics, and comparative analyses. Issues include short articles, conference coverage, charts and photos, a calendar of related events, reviews of discs and projects, opinion, reference materials, and a regular barometer page filled with vital statistics on and from the industry. The publication is international in scope, with correspondents across the United States, and in the United Kingdom, Europe, and Japan.

The Monitor is edited and published by Rockley L. Miller, an acknowledged industry expert who has tracked the field since its beginnings. The Videodisc Monitor has been acclaimed by High Technology magazine as "the best all-around source for videodisc information" and by Paine Webber as "the primary information resource for the videodisc industry."

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